MAR 12 [redacted]

FEMA 1.209:250071/986

COMPLETED

FLOOD INSURANCE STUDY

ORIGINAL

TOWN OF GOSNOLD, MASSACHUSETTS
DUKES COUNTY

JUNE 3, 1986

Federal Emergency Management Agency

COMMUNITY NUMBER - 250071

TABLE OF CONTENTS

		Page
1.0	INTRODUCTION	1
	1.1 Purpose of Study	1
	1.2 Authority and Acknowledgements	1
	1.3 Coordination	1
2.0	AREA STUDIED	2
	2.1 Scope of Study	2
	2.2 Community Description	2
	2.3 Principal Flood Problems	2
	2.4 Flood Protection Measures	5
3.0	ENGINEERING METHODS	5
	3.1 Hydrologic Analyses	5
	3.2 Hydraulic Analyses	7
4.0	FLOOD PLAIN MANAGEMENT APPLICATIONS	11
	4.1 Flood Boundaries	11
5.0	INSURANCE APPLICATION	11
	5.1 Reach Determinations	12
	5.2 Flood Hazard Factors	13
	5.3 Flood Insurance Zones	14
	5.4 Flood Insurance Rate Map Description	14

BEST COPY AVAILABLE

TABLE OF CONTENTS - continued

	Page
6.0 OTHER STUDIES	15
7.0 LOCATION OF DATA	15
8.0 BIBLIOGRAPHY AND REFERENCES	15

FIGURES

Figure 1 - Vicinity Map	3
Figure 2 - Transect Location Map	10

TABLES

Table 1 - Summary of Stillwater Elevations	7
Table 2 - Flood Insurance Zone Data	12 - 13

EXHIBITS

Exhibit 1 - Coastal Profiles

Transect 1	Panel 1C
Transect 2	Panel 2C
Transect 2A	Panel 2AC
Transect 3	Panel 3C
Transect 4	Panel 4C
Transect 5	Panel 5C
Transect 6	Panel 6C
Transect 7	Panel 7C
Transect 8	Panel 8C
Transect 9	Panel 9C

Exhibit 2 - Flood Insurance Rate Map Index
Flood Insurance Rate Map

BEST COPY AVAILABLE

FLOOD INSURANCE STUDY
TOWN OF GOSNOLD, MASSACHUSETTS

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Town of Gosnold, Dukes County, Massachusetts, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in their efforts to promote sound flood plain management. Minimum flood plain management requirements for participation in the National Flood Insurance Program are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were prepared by Anderson-Nichols & Co., Inc., for the Federal Emergency Management Agency (FEMA), under Contract No. H-4605. This work was completed in August 1983.

1.3 Coordination

On August 5, 1977, the existence and severity of flooding within the town were discussed at an initial Consultation and Coordination Officer's (CCO) meeting attended by representatives of FEMA, the Town of Gosnold, and Anderson-Nichols & Co., Inc. (the study contractor). The New England Division of the U. S. Army Corps of Engineers (COE), the U. S. Geological Survey (USGS), the Commonwealth of Massachusetts Department of Public Works, the National Weather Service, and the National Ocean Survey were contacted for various types of information.

BEST COPY AVAILABLE

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Town of Gosnold, Dukes County, Massachusetts. The area of study is shown on the Vicinity Map (Figure 1).

Coastal flooding including its wave action from Vineyard Sound and Buzzards Bay was studied by detailed methods. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction through August 1988.

2.2 Community Description

The Town of Gosnold is located in the northwestern portion of Dukes County in southeastern Massachusetts, approximately 65 miles south of the City of Boston and 14.5 miles south of the City of New Bedford. Gosnold includes approximately 22 islands known as the Elizabeth Islands and is bordered by Buzzards Bay to the north, the Town of Falmouth to the northeast, Vineyard Sound to the south, and the Atlantic Ocean to the southwest. The terrain of the town varies from areas at 0 feet to areas reaching elevations between 100 and 300 feet.

The population of Gosnold was 83 in 1970, an increase of 26 percent over the 1960 population of 66. The islands of the town make up a land area of 12.65 square miles, giving a density of 7 persons per square mile.

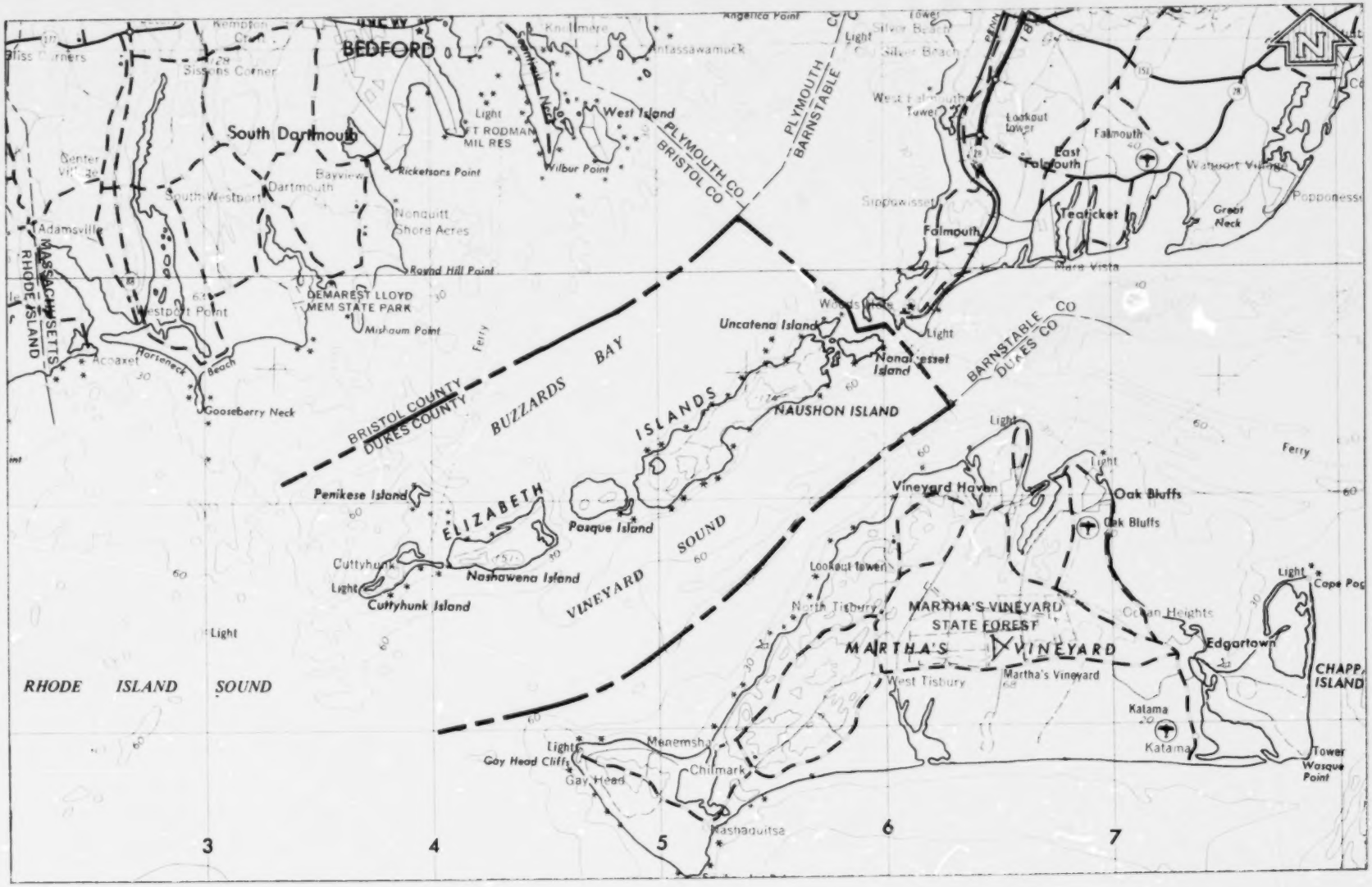
The islands of Naushon, Pasque, and Nashawena are owned by several Forbes trusts. There is a small settlement on Cuttyhunk Island, an area widely known for its sport fishing. However, the southern portion of Cuttyhunk Island is held by two trusts, Wood and Spaulding. Development in the flood plain areas of these islands is scarce and consists mostly of private homes and a few maritime businesses.

Gosnold has a moderate coastal climate with an average rainfall of 43.7 inches per year. The temperature varies from a monthly average of 32.5 degrees Fahrenheit (°F) in January to 67.5°F in July.

2.3 Principal Flood Problems

Each year, Gosnold is subject to extratropical cyclones or hurricanes which cause extreme high tides and the flooding of low-lying areas along the coast. Northeasters also occur in the town, but less frequently. The northeasters can occur at any time of the year but are more prevalent in the winter, whereas hurricanes occur in the late summer and early fall.

BEST COPY AVAILABLE



FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF GOSNOLD, MA
(DUKES CO.)

APPROXIMATE SCALE

4 0 4 8 12 MILES

VICINITY MAP

FIGURE 1

BEST COPY AVAILABLE

The following accounts were written about the memorable 1938 hurricane on Cuttyhunk Island (Reference 1):

> "Wednesday afternoon, September 21, 1938, the island was visited by a ninety mile an hour hurricane and a twelve foot tidal wave. Around 5 p.m. the entire South Beach between the village and the Old Coast Guard Station was covered with angry waves many feet high which swept away the building and planking from the town wharf, demolished boat houses, bath houses, and all the buildings surrounding the Coast Guard Station."
>
> "Between 5 and 6 p.m. buildings situated on the southwest shore of the inner harbor were swept across the harbor and pounded to kindling on the south shore of Copicut Neck. The Old Coast Guard Station was left on an island separated from the village by several feet of water."
>
> "At high tide the entire beach leading to the town wharf was a roaring mass of surf. The road from the town to the wharf along the beach was wrecked."

Included in the accounts of the hurricane of 1944 was the following information (Reference 1):

> "The beach between the village and the Old Coast Guard Station, which had been partially destroyed by the 1938 hurricane, washed completely through and left a tide rip between the village and the station. The road from the village to the town wharf was badly undermined and broken up in many places. Everyone on Cuttyhunk suffered from water which poured into the houses around every east and south window and door"

Tidal levels along the Gosnold coastlines are greatly influenced by the force, duration, and direction of winds as well as the distance across open water or fetch over which these winds act. Tropical storms and hurricanes cause the greatest rise in tide levels in the Elizabeth Islands. This is a result of strong winds following a northerly track across the open ocean. The force of this type of storm is more damaging to the south side of the islands. Northeasters do not create tide levels as high as a tropical storm because the southerly winds have a shorter fetch across Buzzards Bay.

The areas of flooding are minimal in Gosnold, but there are a few buildings near the eastern spit of land that forms the southern side of the entrance to Cuttyhunk Pond and a few near Hadleys Harbor on Naushon Island that are regularly flooded in large storms. Most structures on these islands are built at protected elevations.

BEST COPY AVAILABLE

2.4 Flood Protection Measures

The only major flood protection measures in Gosnold are found on Cuttyhunk Island, where there are two COE projects. The first was completed in 1939, and the second in 1965. The 1939 project includes maintenance of existing jetties at the north and south sides of the east-west entrance into Cuttyhunk Pond. The 1965 project consists of two stone dikes and aprons, one 1,300 feet long at the east end of Canapitsit Beach to protect the entrance channel from the south, and the second 600 feet long at the south end of Copicut Neck Beach to protect the inner harbor from the northwest (Reference 2).

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Analyses were carried out to establish the peak elevation-frequency relationships for the flooding source studied in detail affecting the community.

High-water mark information obtained from the New England Division of the COE and the National Ocean Survey indicates that historic flood elevations at various points on the Elizabeth Islands differ significantly from simultaneous observations at Woods Hole and points directly across Buzzards Bay (References 3 and 4). Therefore, stage-recurrence interval relationships taken from the COE profiles could not be used in this area, and new relationships had to be developed.

BEST COPY AVAILABLE

Hypothetical hurricane windfields were developed using standard methods developed by the National Weather Service Hydrometeorological Branch (Reference 5). The 10-, 50-, 100-, and 500-year windfields were used as input to the COE numerical solution of storm surge due to wind setup over the continental shelf (Reference 6). The numerical solution was first tested for validity by application to the Woods Hole area. Results compared well with surge elevations predicted by the Woods Hole tide gage regression analysis (Reference 7). Results for Cuttyhunk Island (south side) compare well with historic high-water marks on the island. Stage-recurrence interval relationships developed for the Vineyard Sound (south) shore of Cuttyhunk Island were transposed to the north side of the island by a method which took into account the higher spring tides encountered in Buzzards Bay (Reference 8). Stage-recurrence interval relationships for the remaining islands of the Elizabeth Island chain were interpolated from profiles determined by straight-lining stage-recurrence interval relationships between Cuttyhunk Island and Woods Hole.

Available high-water mark data for the 1938 storm are shown in the following tabulation:

Location	Elevation (feet)
Cuttyhunk Island	
North side	10.9
Nashawena Island (at Robinson's Hole)	
North side	10.85
South side	9.85
Naushon Island (center of island)	
North side	11.7
South side (Tarpaulin Cove)	9.05
Naushon Island	
Hadleys Harbor	8.81

The stillwater elevations for the 10-, 50-, 100-, and 500-year floods have been determined for Vineyard Sound and Buzzards Bay and are shown in Table 1. The analyses reported herein reflect the stillwater elevations due to tidal and wind setup effects, and include the contributions from wave action effects.

The effects of wave action were also considered in the determination of flood hazard areas. Coastal structures which are located above stillwater flood elevations can still be severely damaged by wave runup, wave-induced erosion, and wave-borne debris. For example, during the February 1978 northeaster, considerable damage along the Massachusetts

BEST COPY AVAILABLE

TABLE 1 - SUMMARY OF STILLWATER ELEVATIONS

FLOODING SOURCE AND LOCATION	ELEVATION (feet) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
VINEYARD SOUND				
At Woods Hole	5.2	9.0	11.0	15.8
At Tarpaulin Cove, Naushon Island	5.5	9.0	10.9	15.0
At the west end of Naushon Island	5.6	9.1	10.8	14.7
At Pasque Island	5.7	9.1	10.8	14.5
At Nashawena Island	5.9	9.2	10.7	14.1
At Cuttyhunk Island	6.1	9.2	10.6	13.6
BUZZARDS BAY				
At Woods Hole	7.9	11.6	13.0	16.6
At Kettle Cove, Naushon Island	7.4	10.9	12.3	15.7
At the west end of Naushon Island	7.1	10.5	11.9	15.2
At Pasque Island	7.0	10.3	11.6	15.0
At Nashawena Island	6.7	9.9	11.2	14.4
At Cuttyhunk Island	6.3	9.4	10.7	13.7

coast was caused by wave activity, even though most of the damaged structures were above the high-water level. The extent of wave runup past stillwater levels depends greatly on the wave conditions and local topography.

Wave heights and corresponding wave crest elevations were determined using the National Academy of Sciences (NAS) methodology (Reference 9). The wave runup was determined using the methodology developed by Stone & Webster Engineering Corporation for FEMA (Reference 10).

3.2 Hydraulic Analyses

Hydraulic analyses, considering storm characteristics and the shoreline and bathymetric characteristics of the flooding sources studied, were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each of the shorelines.

Areas of coastline subject to significant wave attack are referred to as coastal high hazard zones. The COE has established the 3-foot breaking wave as the criterion for identifying the limit of coastal high hazard

BEST COPY AVAILABLE

zones (Reference 11). The 3-foot wave has been determined as the minimum size wave capable of causing major damage to conventional wood frame or brick veneer structures.

A wave height analysis was performed to determine wave heights and corresponding wave crest elevations for the areas inundated by the tidal flooding. A wave runup analysis was performed to determine the height and extent of runup beyond the limit of tidal inundation. The results of these analyses were combined into a wave envelope, which was constructed by extending the maximum wave runup elevation seaward to its intersection with the wave crest profile.

The methodology for analyzing wave heights and corresponding wave crest elevations was developed by the NAS (Reference 9). The NAS methodology is based on three major concepts.

First, a storm surge on the open coast is accompanied by waves. The maximum height of these waves is related to the depth of water by the following equation:

$$H_b = 0.78d$$

where H_b is the crest to trough height of the maximum or breaking wave and d is the stillwater depth. The elevation of the crest of an unimpeded wave is determined using the equation:

$$Z_w = S_* + 0.7H_* = S_* + 0.55d$$

where Z_w is the wave crest elevation, S_* is the stillwater elevation at the site, and H_* is the wave height at the site. The 0.7 coefficient is the portion of the wave height which reaches above the stillwater elevation. H_b is the upper limit for H_*.

The second major concept is that the breaking wave height may be diminished by dissipation of energy by natural or man-made obstructions. The wave height transmitted past a given obstruction is determined by the following equation:

$$H_t = BH_i$$

where H_t is the transmitted wave height, H_i is the incident wave height, and B is a transmission coefficient ranging from 0.0 to 1.0. The coefficient is a function of the physical characteristics of the obstruction. Equations have been developed by the NAS to determine B for vegetation, buildings, natural barriers such as dunes, and man-made barriers such as breakwaters and seawalls (Reference 9).

BEST COPY AVAILABLE

The third concept deals with unimpeded reaches between obstructions. New wave generation can result from wind action. This added energy is related to distance and mean depth over the unimpeded reach.

The methodology for analyzing wave runup was developed by Stone and Webster Engineering Corporation (Reference 10). The wave runup computer program operates using an ensemble of deepwater wave heights, H_i, the stillwater elevation, S*, a wave period, T_s, and beach slope, m. For Gosnold, wave heights range from 3 feet up to the significant wave height of 24 feet; the wave periods range from 3.6 to 9 seconds.

These concepts and equations were used to compute wave envelope elevations associated with the 100-year storm surge. Accurate topographic, land-use, and land cover data are required for the coastal analyses. Maps of the study area, at a scale of 1:24,000 enlarged to 1:12,000 with a contour interval of 10 feet, were used for the topographic data (Reference 12). The land-use and land cover data were obtained by field surveys.

Wave heights and wave runup were computed along transects which were located perpendicular to the average mean shoreline. The transects were located with consideration given to the physical and cultural characteristics of the land so that they would closely represent conditions in their locality. Transects were spaced close together in areas of complex topography and dense development. In areas having more uniform characteristics, the transects were spaced at larger intervals. It was also necessary to locate transects in areas where unique flooding existed and in areas where computed wave heights varied significantly between adjacent transects. Figure 2, "Transect Location Map," illustrates the location of the transects for the community.

Along each transect, wave envelope elevations were computed considering the combined effects of changes in ground elevation, vegetation, and physical features. Between transects, elevations were interpolated using the topographic maps, land-use and land cover data, and engineering judgment to determine the areal extent of flooding. The results of the calculations are accurate until local topography, vegetation, or cultural development within the community undergo any major changes. Selected beach transects with stillwater elevations for the 10- and 100-year recurrence intervals and wave envelope profiles for the 100-year recurrence interval are shown on the Coastal Profiles (Exhibit 1).

A wave runup analysis was performed for only the Vineyard Sound shoreline of Gosnold; a runup analysis was not performed on the north-facing Buzzards Bay coastline due to significant wave shadow effects. A wave height analysis was performed on the Buzzards Bay shoreline, resulting in wave heights of less than 3 feet. Penikese Island and Gull Island are subject to significant wave attack due to their exposure to winds from the south.

BEST COPY AVAILABLE

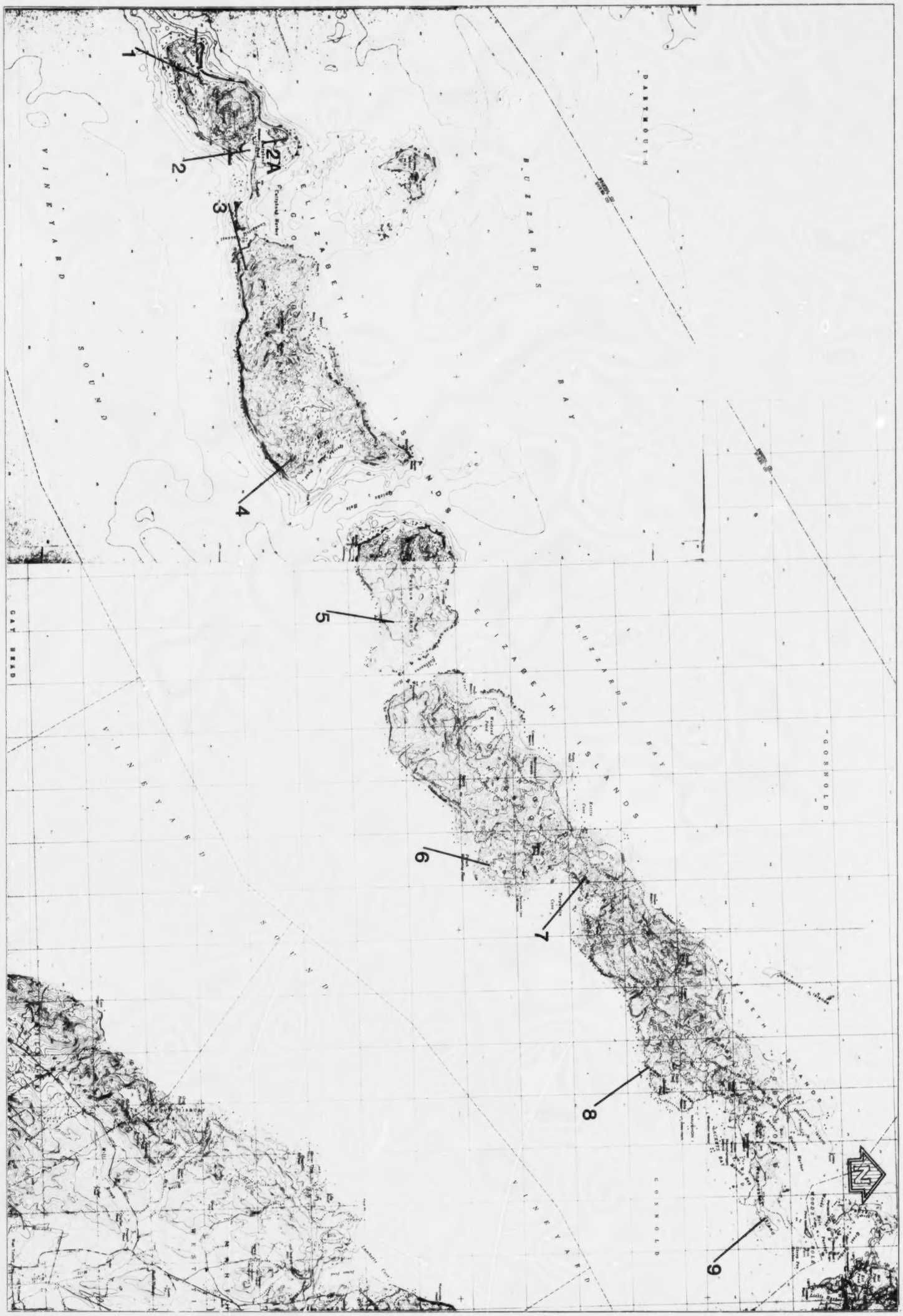


FIGURE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF GOSNOLD, MA
(DUKES CO.)

APPROXIMATE SCALE

5800 0 5800 11,600 17,400 FEET

TRANSECT LOCATION MAP

10

BEST COPY AVAILABLE

All elevations used in this study are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used are shown on the maps.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages State and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study produces maps designed to assist communities in developing flood plain management measures.

4.1 Flood Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for flood plain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For tidal areas without wave action, the 100-year and 500-year boundaries were delineated using USGS topographic maps at a scale of 1:24,000 enlarged to a scale of 1:12,000 with a contour interval of 10 feet (Reference 12). For the tidal areas with wave action, the flood boundaries were delineated using the elevations determined at each transect; between transects, the boundaries were interpolated using engineering judgment, land-cover data, and USGS topographic maps referenced above. The 100-year flood plain was divided into whole-foot elevation zones based on the average wave envelope elevation in that zone. Where the map scale did not permit these zones to be delineated at one foot intervals, larger increments were used.

The 100- and 500-year flood plain boundaries are shown on the Flood Insurance Rate Map (Exhibit 2). In cases where the 100- and 500-year flood plain boundaries are close together, only the 100-year flood plain boundary has been shown. Small areas within the flood plain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

5.0 INSURANCE APPLICATION

To establish actuarial insurance rates, data from the engineering study must be transformed into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone designations for each flooding source studied in detail in the Town of Gosnold.

5.1 Reach Determinations

Reaches are defined as sections of flood plain that have relatively the same flood hazard. In areas where wave height and wave runup analyses were performed, reaches were determined for areas of the coastline, represented by a transect or group of transects, which have the same physical characteristics. For each transect the coastal high hazard zone (V zone) may be divided into two reaches to reflect those areas where wave runup is a dominant factor and those areas where wave runup does not dominate and elevations are determined by the wave height analysis. The reaches determined for the Town of Gosnold are summarized in Table 2.

TABLE 2 - FLOOD INSURANCE ZONE DATA

Flooding Source	Stillwater Elevation 10-Year	Stillwater Elevation 100-Year	FHF	Zone	Base Flood Elevation (Feet NGVD)*
Vineyard Sound					
Woods Hole	5.2	11.0	060	V12	14-27
			090	V18	13-17
			060	A12	11-18
			065	A13	11-13
Tarpaulin Cove	5.5	10.9	055	V11	18
			085	V17	13-17
			065	A13	11-13
			055	A11	11
Naushon Island (West End)	5.6	10.8	050	V10	18-27
			080	V16	13-17
			050	A10	11-13
Pasque Island	5.7	10.8	050	V10	18
			080	V16	13-17
			060	A12	11-13
			065	A13	11-13
Nashawena Island	5.9	10.7	050	V10	17-28
			075	V15	13-17
			050	A10	11
			060	A12	11-13
Cuttyhunk Island	6.1	10.6	045	V9	16-30
			070	V14	13-16
			060	A12	11-13

*Due to map scale limitations, base flood elevations shown on the FIRM represent average elevations for the zones depicted.

BEST COPY AVAILABLE

TABLE 2 - FLOOD INSURANCE ZONE DATA - continued

Flooding Source	Stillwater Elevation 10-Year	100-Year	FHF	Zone	Base Flood Elevation (Feet NGVD)*
Buzzards Bay					
Woods Hole	7.9	13.0	050	A10	13
			065	A13	13-14
Kettle Cove	7.4	12.3	055	A11	12-13
			065	A13	12-14
Naushon Island					
(West End)	7.1	11.9	050	A10	12
			060	A12	12-13
Pasque Island	7.0	11.6	045	A9	12
			055	A11	12
			060	A12	12-13
Nashawena Island	6.7	11.2	045	A9	11
			060	A12	11-13
Cuttyhunk Island	6.3	10.7	045	A9	11
			050	A10	11
			060	A12	12
Penikese Island					
and Gull Island	6.3	10.7	070	V14	13-17
			060	A12	11-13

*Due to map scale limitations, base flood elevations shown on the FIRM represent average elevations for the zones depicted.

5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is used to establish relationships between depth and frequency of flooding in any reach. This relationship is then used with depth-damage relationships for various classes of structures to establish actuarial insurance rate tables.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations rounded to the nearest one-half foot, multiplied by 10, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year flood water-surface elevations is greater than 10.0 feet, it is rounded to the nearest whole foot.

BEST COPY AVAILABLE

5.3 Flood Insurance Zones

Flood insurance zones and zone numbers are assigned based on the type of flood hazard and the FHF, respectively. A unique zone number is associated with each possible FHF, and varies from 1 for a FHF of 005 to a maximum of 30 for a FHF of 200 or greater.

Zones A9, A10, A11, A12, and A13:	Special Flood Hazard Areas inundated by the 100-year flood; with base flood elevations shown, and zones subdivided according to FHFs.
Zones V9, V10, V11, V12, V14, V15, V16, V17, and V18:	Special Flood Hazard Areas along coasts inundated by the 100-year flood that have additional velocity hazards associated with waves of 3-foot amplitude or greater; with base flood elevations shown, and zones subdivided according to FHFs.
Zone B:	Areas between the Special Flood Hazard Areas and the limits of the 500-year flood; areas that are protected from the 100- or 500-year floods by dike, levee, or other water control structure; areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flooding; not subdivided.

Flood elevation differences, FHFs, flood insurance zones, and base flood elevations for the flooding sources studied in detail in the community are shown in Table 2.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the Town of Gosnold is, for insurance purposes, the principal result of the Flood Insurance Study. This map contains the official delineation of flood insurance zones and base flood elevations. Base flood elevation lines show the locations of the expected whole-foot water-surface elevation of the base (100-year) flood. The base flood elevations and zone numbers are used by insurance agents, in conjunction with structure elevations and characteristics, to assign actuarial insurance rates to structures and contents insured under the National Flood Insurance Program.

BEST COPY AVAILABLE

6.0 OTHER STUDIES

Studies relating to tidal flooding have been prepared for other communities in this part of Massachusetts. The New England Division of the COE published a hurricane survey for Wareham and Marion (Reference 13). Data from the survey were used in the development and subsequent publication of the Buzzards Bay flood profile in 1975 (Reference 4). A comparison of high-water marks from the Buzzards Bay profile and high waters of record for National Ocean Survey tide gages on the Elizabeth Island chain indicate flood levels on the islands are substantially lower than simultaneous levels directly across Buzzards Bay on mainland Massachusetts. For this reason, the Buzzards Bay profile was not used as the source of elevations for the Gosnold study.

The New England Division of the COE published a technical review and restudy of the Flood Insurance Study for Falmouth in 1975 (Reference 7). Flood elevations for the eastern terminus of the Elizabeth Island chain match exactly with the Falmouth study elevations for Woods Hole. Historic high-water marks for the more western islands of the Elizabeth Island chain indicate lower flood levels than for the same events at Woods Hole. Therefore, flood elevations for the more western Elizabeth Islands in this study were determined by other methods.

Data in this study agree well with high-water marks published by the COE in 1977 and with high waters of record from National Ocean Survey subordinate tide gages on the Elizabeth Islands (Reference 3).

The Flood Insurance Study for the Town of Falmouth is currently being revised (Reference 14). The results of that study will be in exact agreement with the results of this study.

7.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, Federal Emergency Management Agency, Regional Director, Region I Office, J. W. McCormack Post Office and Courthouse Building, Room 462, Boston, Massachusetts 02109.

8.0 BIBLIOGRAPHY AND REFERENCES

1. Louise T. Haskell, The Story of Cuttyhunk, New Bedford, Massachusetts, American Press, Inc., 1976.

2. U. S. Army Corps of Engineers, New England Division, Water Resources Development in Massachusetts, Waltham, Massachusetts, 1975.

BEST COPY AVAILABLE

3. U. S. Army Corps of Engineers, New England Division, Coastal Flood Profile No. 8, Waltham, Massachusetts, Revised 1977.

4. U. S. Army Corps of Engineers, New England Division, Coastal Flood Profiles for Buzzards Bay, Waltham, Massachusetts, Revised July 1975.

5. U. S. Department of Commerce, National Oceanic and Atomspheric Administration, Memorandum HUR 7-120, Preliminary, Revised Standard Project Hurricane Criteria for the Atlantic and Gulf Coasts of the United States, Hydrometeorological Branch, Office of Hydrology, National Weather Service, Silver Spring, Maryland, June 1972.

6. U. S. Army Corps of Engineers, Beach Erosion Board, Office of the Chief of Engineers, Technical Report No. 4, Shore Protection Planning and Design, Volume 1, Washington, D. C., 1966.

7. U. S. Army Corps of Engineers, New England Division, Technical Review and Restudy of Type 15 Flood Insurance Study, Falmouth, Massachusetts, Waltham, Massachusetts, September 1975.

8. U. S. Department of Commerce, National Ocean Survey, Tidal Benchmarks for Massachusetts, Washington, D. C., Published Continuously.

9. National Academy of Sciences, Methodology for Calculating Wave Action Effects Associated with Storm Surges, Washington, D. C., 1977.

10. Stone & Webster Engineering Corporation, Manual for Wave Runup Analysis, Coastal Flood Insurance Studies, Boston, Massachusetts, November 1981.

11. U. S. Army Corps of Engineers, Galveston District, Guidelines for Identifying Coastal High Hazard Zones, Galveston, Texas, June 1975.

12. U. S. Department of the Interior, Geological Survey, 7.5-Minute Series Topographic Maps, Scale 1:24,000, Contour Interval 10 Feet: Cuttyhunk Island, Massachusetts, 1942, Photorevised 1972; Vineyard Haven, Massachusetts, 1942, Photorevised 1972; Woods Hole, Massachusetts, 1936, Photorevised 1967.

13. U. S. Army Corps of Engineers, New England Division, Interim Hurricane Survey for Wareham and Marion, Massachusetts, Waltham, Massachusetts, September 1962.

14. Federal Emergency Management Agency, Flood Insurance Study, Town of Falmouth, Barnstable County, Massachusetts (Unpublished).

Commonwealth of Massachusetts, Department of Commerce and Development, Massachusetts Profile of Dukes County (Unpublished).

BEST COPY AVAILABLE

Commonwealth of Massachusetts, Department of Public Works, Geodetic Survey, Storm-Tide Hurricane of September 1938 in Massachusetts, Supplemented by High-Water Data Flood of March 1936 and September 1938, Boston, Massachusetts, 1939.

Commonwealth of Massachusetts, Water Resources Commission, Coastal Flooding in Barnstable County, Cape Cod, Massachusetts, Boston, Massachusetts, March 1963.

U. S. Army Corps of Engineers, Coastal Engineering Research Center, Shore Protection Manual, Volume 1, Fort Belvoir, Virginia, 1973.

U. S. Army Corps of Engineers, Coastal Engineering Research Center, Storm Surge on the Open Coast: Fundamentals and Simplified Protection Manual by B. R. Bodine, Washington, D. C., May 1971.

U. S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service, HUR 7-120: Revised Standard Project Hurricane Criteria for the Atlantic and Gulf Coasts of the United States, Silver Spring, Maryland, June 1972.

U. S. Department of Commerce, National Oceanic and Atmospheric Administration, Report No. 68, Criteria for a Standard Project Northeaster for New England North of Cape Cod, Washington, D. C., March 1964.

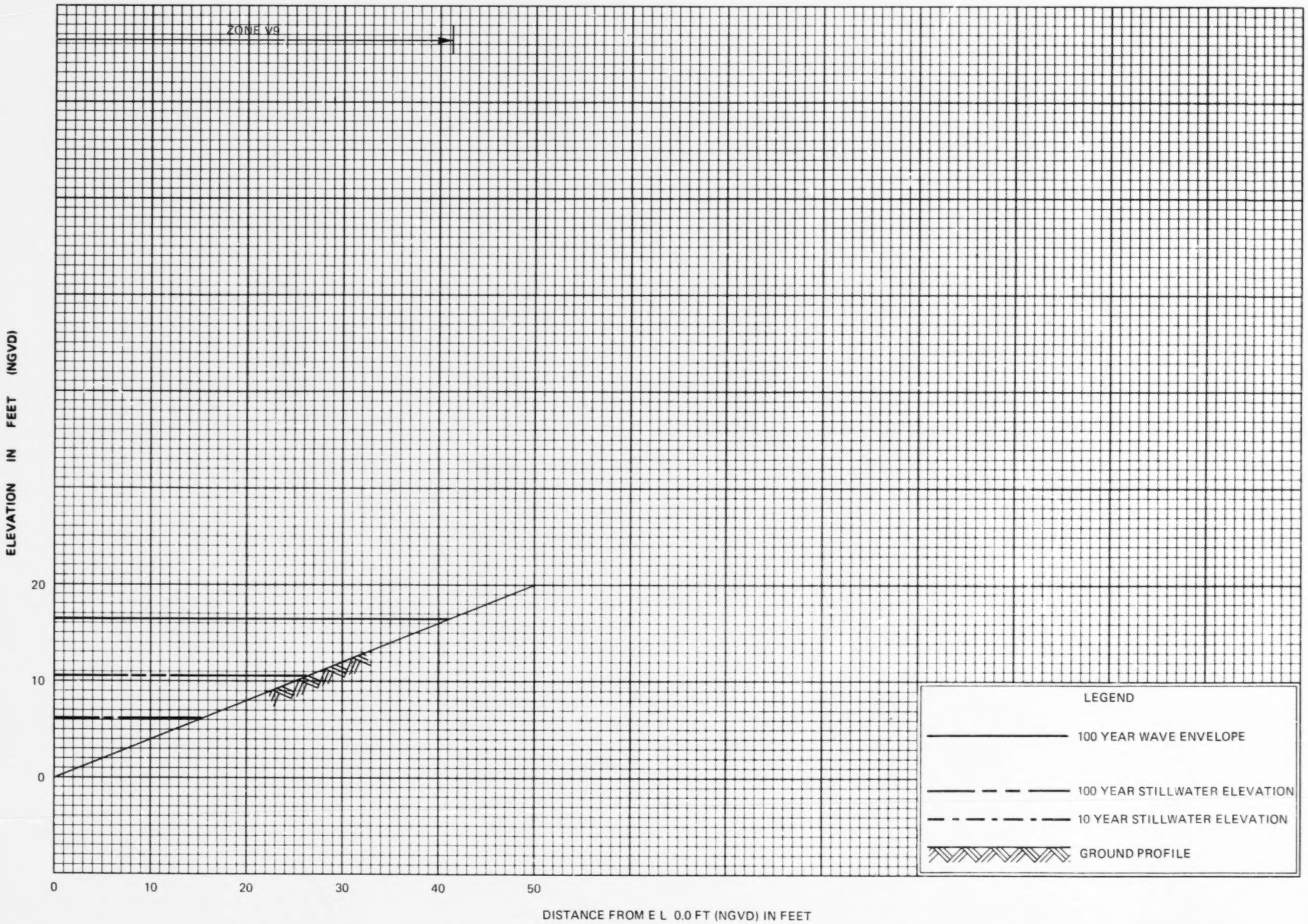
U. S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service, Memorandum HUR 7-97: Meteorological Characteristics of the Probable Maximum Hurricane, Silver Spring, Maryland, December 1968.

U. S. Department of Commerce, National Oceanic and Atmospheric Administration, Weather Bureau, Memorandum No. 7-97A, Asymptotic and Peripheral Pressures for Probable Maximum Hurricane, Silver Spring, Maryland, December 1968.

U. S. Department of Commerce, National Oceanic and Atmospheric Administration, Weather Bureau, Preliminary Memorandum No. HUR 7-79, Meteorological Characteristics of the Probable Maximum Hurricane, Atlantic and Gulf Coasts of the United States, Silver Spring, Maryland, December 1968.

U. S. Department of Commerce, National Oceanic and Atmospheric Administration, Weather Bureau, Technical Report National Weather Service 15, Some Climatological Characteristics of Hurricanes and Tropical Storms, Gulf and East Coasts of the United States, Washington, D. C., May 1975.

BEST COPY AVAILABLE



COASTAL PROFILES

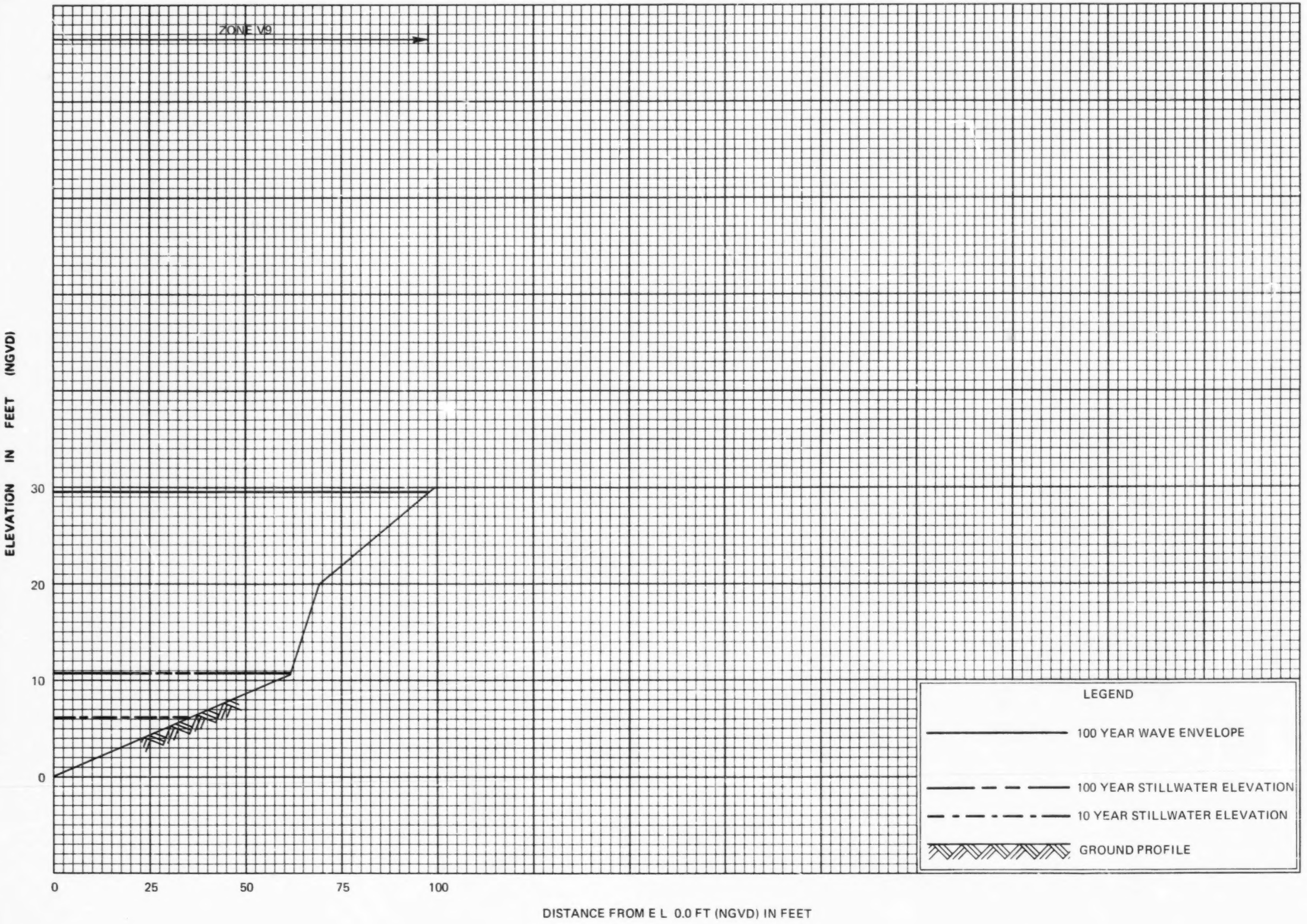
TRANSECT 2A

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF GOSNOLD, MA
(DUKES CO.)

02AC

BEST COPY AVAILABLE



COASTAL PROFILES

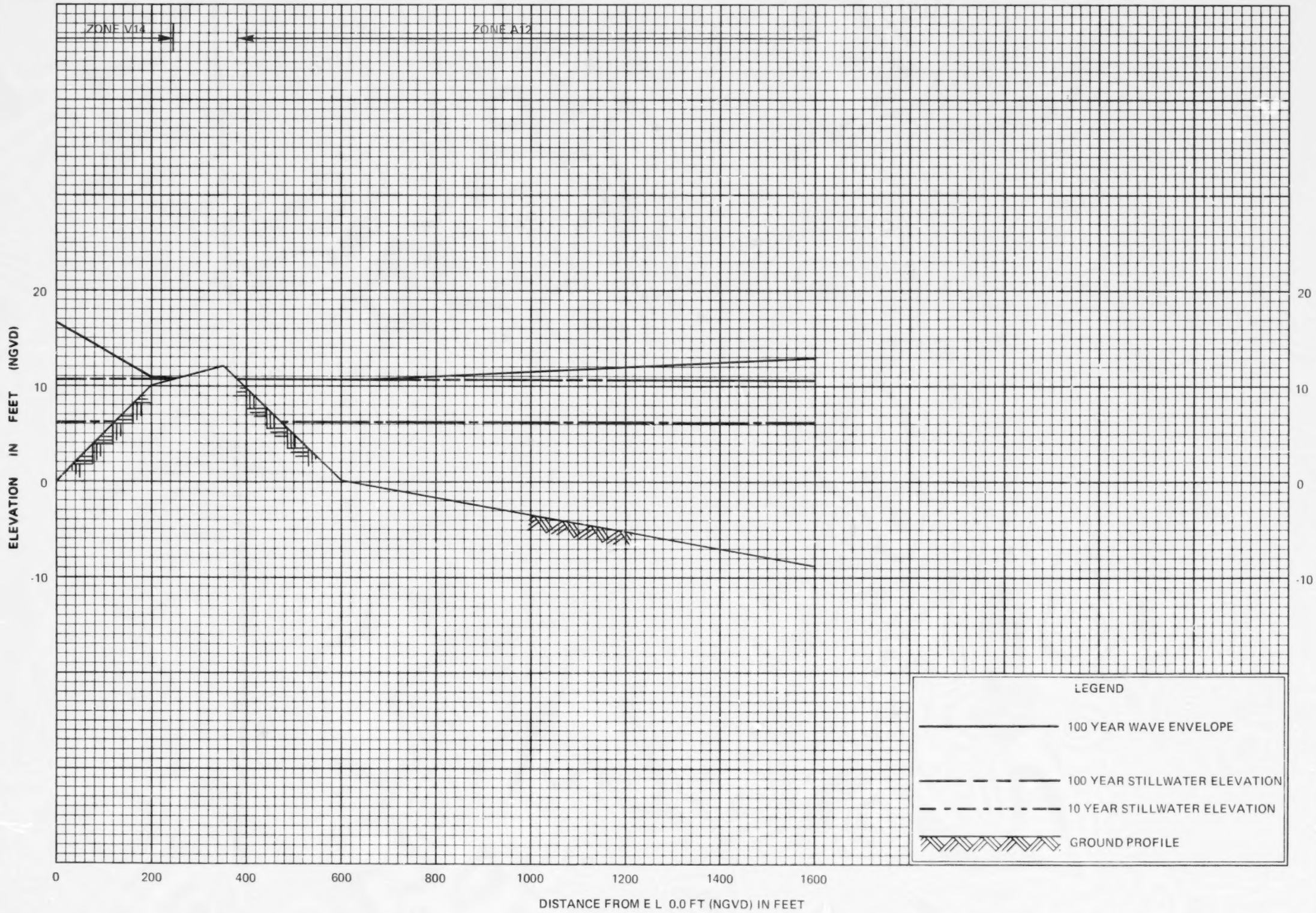
TRANSECT 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF GOSNOLD, MA
(DUKES CO.)

O1C

BEST COPY AVAILABLE



COASTAL PROFILES

TRANSECT 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF GOSNOLD, MA
(DUKES CO.)

02C

BEST COPY AVAILABLE

ELEVATION IN FEET (NGVD)

0 10 20

0 50 100 150 200 250 300 350

ZONE V10

DISTANCE FROM E L 0.0 FT (NGVD) IN FEET

0 10 20

LEGEND

100 YEAR WAVE ENVELOPE

100 YEAR STILLWATER ELEVATION

10 YEAR STILLWATER ELEVATION

GROUND PROFILE

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF GOSNOLD, MA
(DUKES CO.)

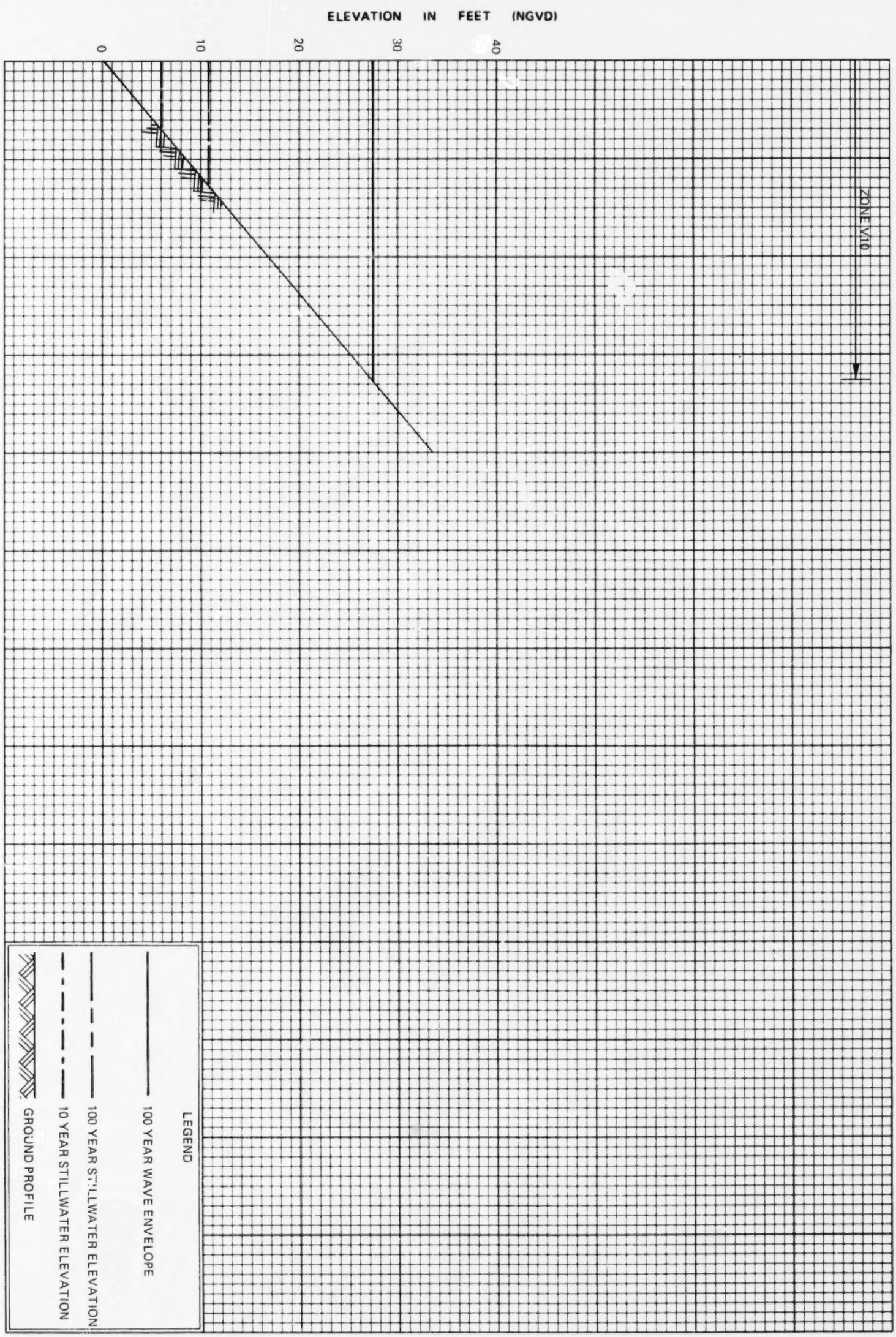
COASTAL PROFILES

TRANSECT 3

03C

21

BEST COPY AVAILABLE



FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF GOSNOLD, MA
(DUKES CO.)

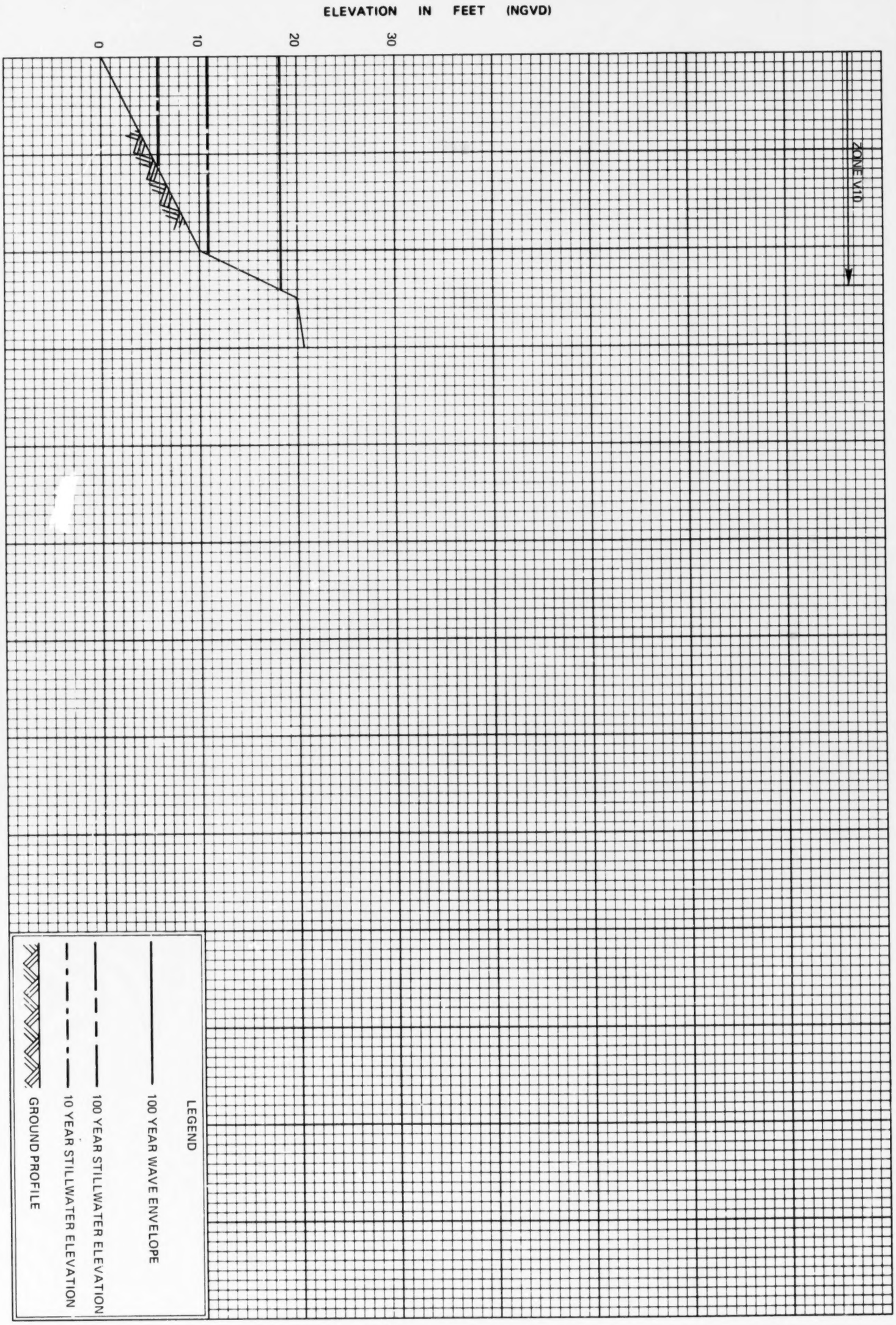
COASTAL PROFILES

TRANSECT 4

04C

22

BEST COPY AVAILABLE



23

FEDERAL EMERGENCY MANAGEMENT AGENCY

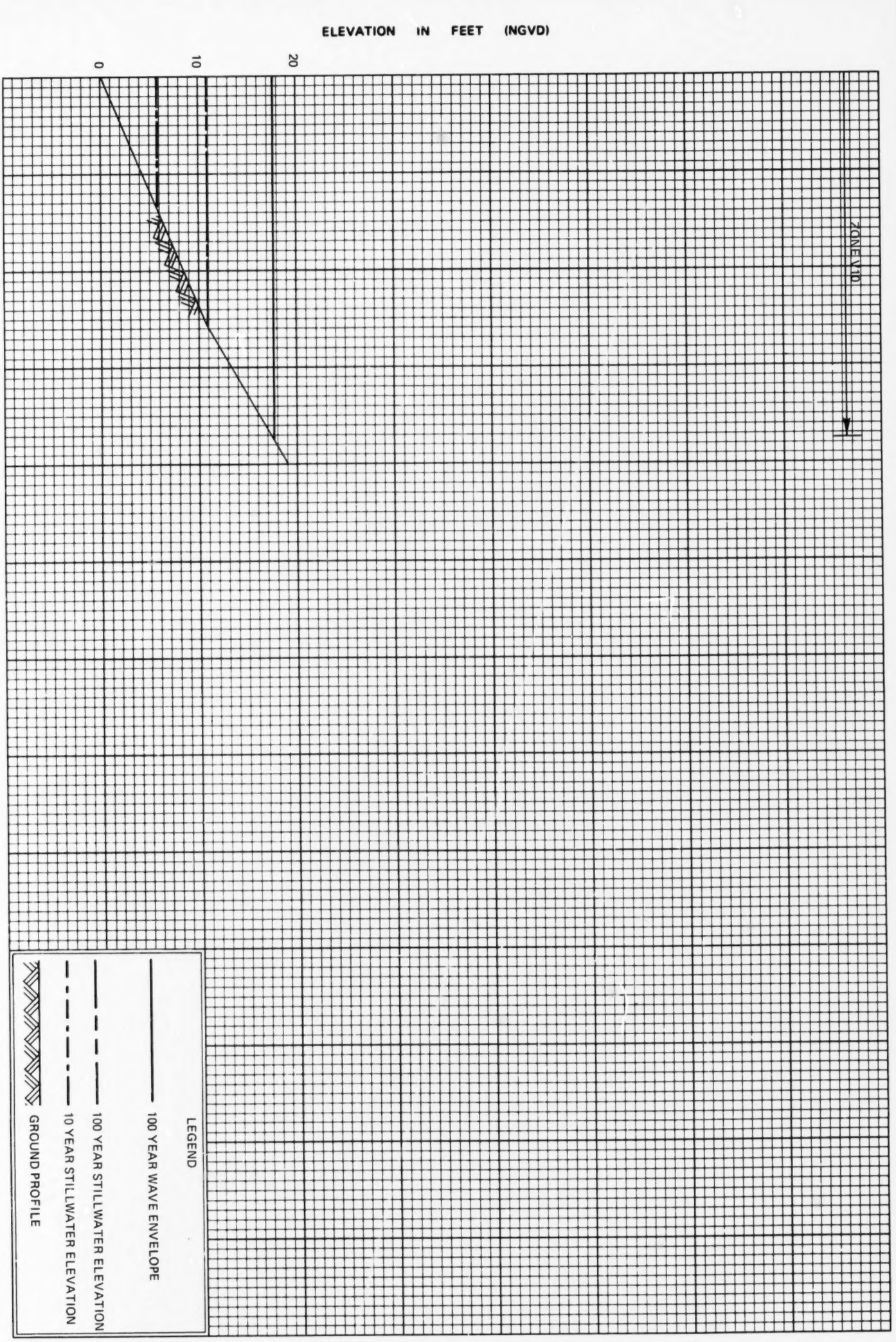
TOWN OF GOSNOLD, MA
(DUKES CO.)

05C

COASTAL PROFILES

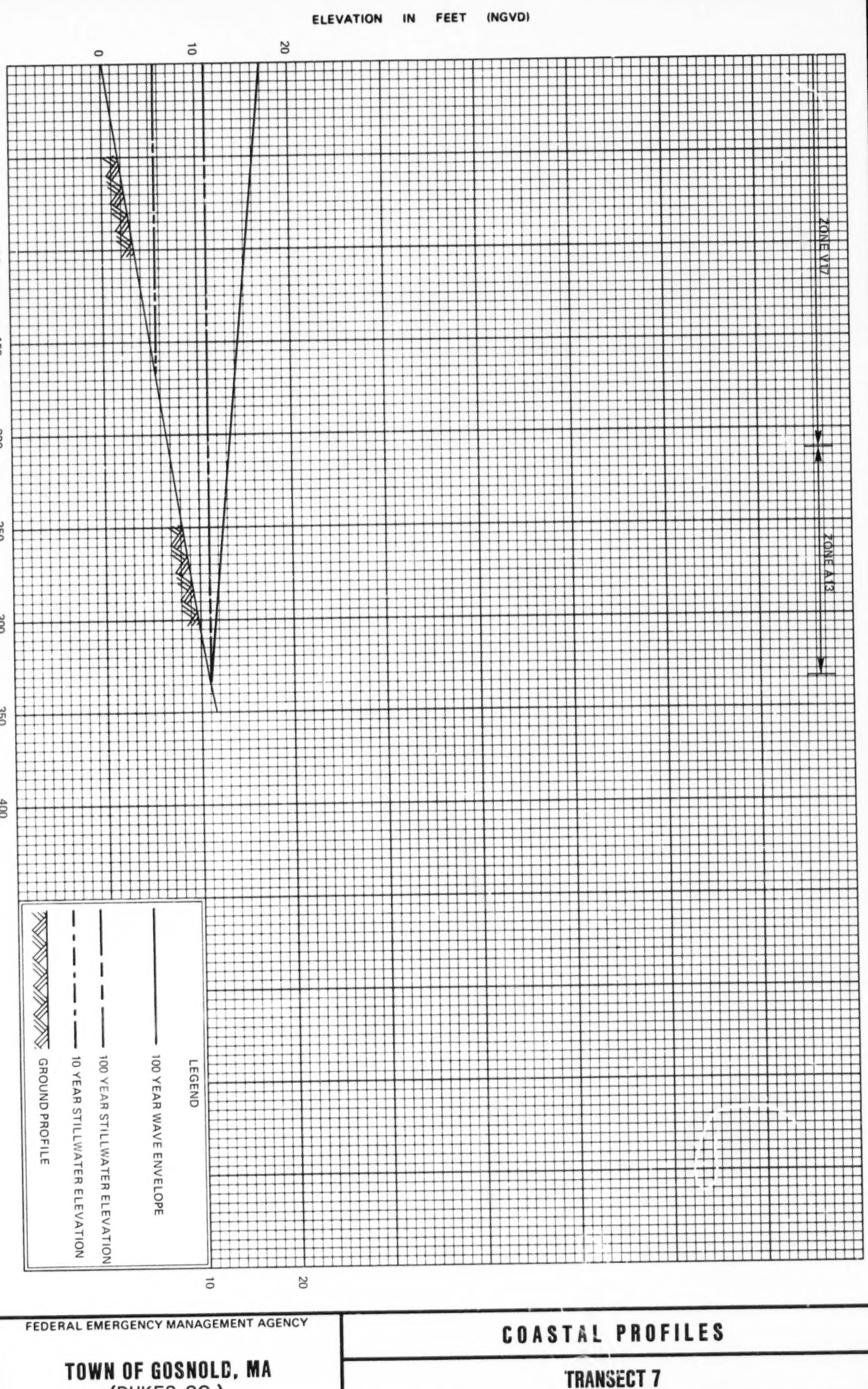
TRANSECT 5

BEST COPY AVAILABLE



06C	FEDERAL EMERGENCY MANAGEMENT AGENCY **TOWN OF GOSNOLD, MA** (DUKES CO.)	**COASTAL PROFILES** **TRANSECT 6**

BEST COPY AVAILABLE



FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF GOSNOLD, MA
(DUKES CO.)

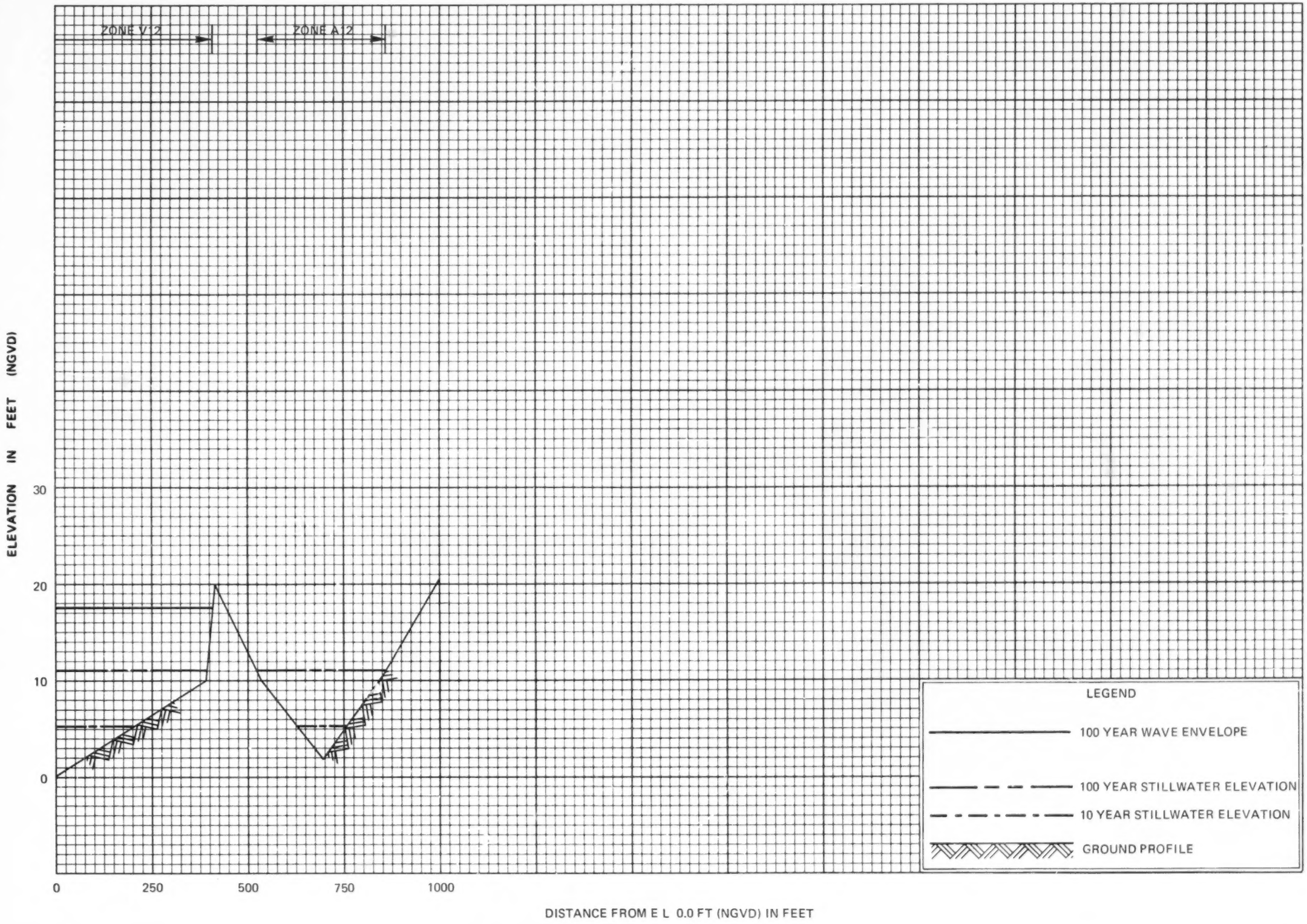
07C

COASTAL PROFILES

TRANSECT 7

25

BEST COPY AVAILABLE



COASTAL PROFILES

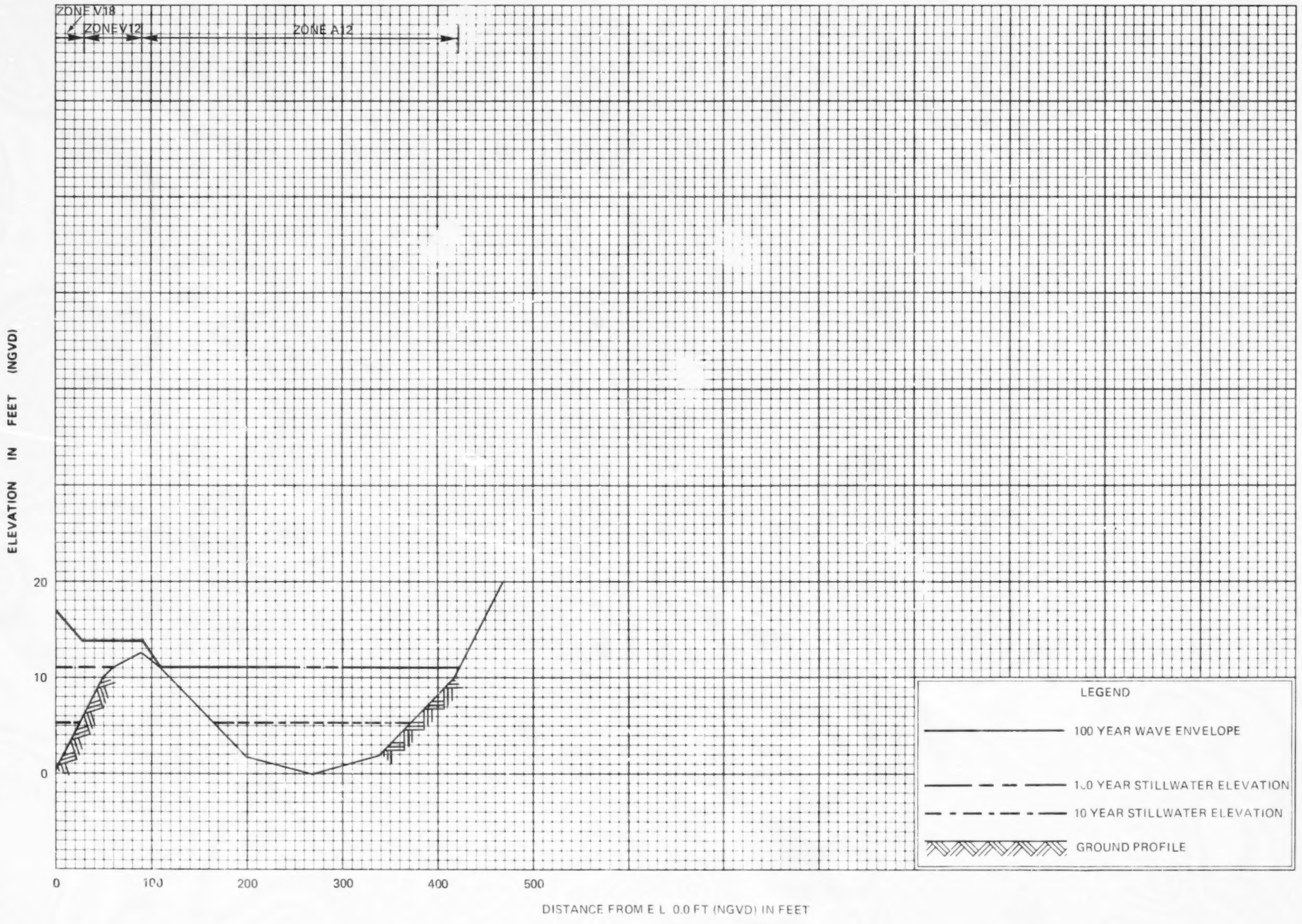
TRANSECT 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF GOSNOLD, MA
(DUKES CO.)

08C

BEST COPY AVAILABLE



COASTAL PROFILES

TRANSECT 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF GOSNOLD, MA
(DUKES CO.)

09C

BEST COPY AVAILABLE